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METHOD FOR NOISE MEASUREMENT OF AGRICULTURAL TRACTORS

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Indian Standard

METHOD FOR NOISE MEASUREMENT OF AGRICULTURAL TRACTORS

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(*Continued on page* 2)

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Indian Standard

METHOD FOR NOISE MEASUREMENT OF AGRICULTURAL TRACTORS

0. FOREWORD

0.1 This Indian Standard was adopted by the Bureau of Indian Standards on 30 June 1987, after the draft finalized by the Agricultural Tractors and Power Tillers Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 With the increasing emphasis on safety and comfort of the operators and bystanders, efforts are being made to reduce the noise level from agricultural tractors to an acceptable limit. A need was, therefore, felt to formulate this standard at the first instance for laying down the methodology for measuring the noise level.

0.3 In the preparation of this standard, assistance has been taken from the following:

ISO 5131-1982 Acoustics — Tractors and machinery for agriculture and forestry — Measurement of noise at the operator's position — Survey method. International Organization for Standardization.

ISO/DIS 7216 Acoustics — Agricultural and forestry wheeled tractors and self-propelled machines — Measurement of noise emitted in motion. International Organization for Standardization.

0.4 In reporting the result of a test, made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard covers methodology for measuring noise of agricultural tractors at the operator's and the bystander's positions.

---

*Rules for rounding off numerical values (*revised*).

2. GENERAL

2.1 The values measured shall be A-weighted sound pressure levels for the overall sound levels expressed in decibels. Spectral analysis is optional. If required, the values measured shall be octave band sound pressure levels in decibels.

2.2 Measuring Instruments

2.2.1 A suitable measuring device is a sound level meter meeting or exceeding the requirements of a Type 1 instrument according to IS : 9779-1981*. A wind screen attachment to the microphone may be used, if necessary, provided that this is allowed for in the calibration and does not significantly alter the measured sound pressure level as a consequence of its effect on the omnidirectional characteristics of the microphone.

2.2.2 If alternative measuring equipment, including, for example, a tape recorder and/or level recorder, is used, the tolerances of several sections of the measuring chain shall not exceed the tolerances of the relevant clauses of IS : 9779-1981*. If a tape recorder is used as part of the measuring equipment, it may be necessary to include suitable weighting networks for recording and reproduction to provide an adequate signal to noise ratio over the whole frequency range of interest.

2.2.2.1 Measurement of the sound frequency spectrum shall be carried out using a frequency analyser fitted with octave filters in accordance with IS : 6964-1973†.

NOTE — Care shall be taken, particularly when a microphone with a diameter of more than 13 mm is used, to ensure that microphone characteristics do not lead to errors when the sound is directional. It is recommended that, when necessary, a random incidence adaptor be used to ensure that the omnidirectionality is not worse than that of a Type 2 microphone as specified in IS : 9779-1981*.

2.2.3 The calibration of the equipment at the time of the measurements shall be in accordance in all respect with IS : 9779-1981*. Calibration shall be carried out at appropriate intervals and at least before and after each measurement session using an acoustical calibrator with an accuracy of ± 0·5 dB at a known frequency in the range 250 to 1 000 Hz.

2.2.3.1 The calibrator shall be checked annually to verify its output and its initial calibration shall be traceable to a national standards laboratory.

2.3 Meteorological Conditions

2.3.1 The test shall not be carried out in adverse weather conditions which are likely to influence the measurements.

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*Specification for sound level meters.

†Specification for octave, half-octave and third-octave band filters for analysis of sound and vibrations.

2.3.2 The wind velocity at microphone height shall not exceed 3 m/s. Care shall be taken to ensure that wind effect does not distort the results.

2.4 Background Noise — The level of the background noise including wind noise shall be at least 10 dB below the level measured during the test. Where spectral analysis is required, the level of the background noise shall be at least 10 dB below the corresponding level in each frequency band as measured during the test.

2.5 Acoustical Environment

2.5.1 The test area shall be a flat and open space and, within at least 20 m of the test tractor, there shall be no obstacle likely to reflect the significant sound, such as a building, solid fence, tree or other vehicle.

2.5.2 No person other than the operator of the tractor shall be in the driving position or cab during measurements. Where the noise at the position of other operators on the tractor is being measured, the usual number of operators shall be present. No person other than the operators(s) shall be in such a position as to influence the sound level measurements.

2.6 Tractor Condition

2.6.1 The tractor shall comply with the manufacturer's product specification and shall be operated in accordance with his published instructions.

2.6.2 If the tractor is fitted with more than two wheel drive, it shall be tested in the drive which is intended for normal road use.

2.6.3 The tractor shall be unballasted. Wheeled tractors shall be fitted with normal pneumatic tyres, not more than 50 percent worn. Before the noise measurement, it shall be established by a power take-off test or other means that the power of the tractor is within 10 percent of the manufacturer's declared value.

2.6.4 The measurement procedure applies whether or not the tractor is fitted with a cab. If a cab is fitted, the noise shall be measured with all doors and windows closed. The noise measurements may optionally be repeated with all windows open.

3. MEASUREMENT AT OPERATOR'S POSITION

3.1 Operational Conditions

3.1.1 For these measurements, tractors with pneumatic tyres shall be operated on a dry, horizontal concrete or tarmacadam surface free from gravel, leaves, snow, etc. Tracked and metal-wheeled tractors shall be operated on a smooth, horizontal grassland or soil surface free from long grass and vegetation. The test track or course shall have a straight section of at least 150 m to ensure that the tractor speed is stabilized for an adequate time for measurements to be made, particularly in the higher gears.

3.1.2 The measurements shall be made away from agricultural work. For maximum precision, the test with the tractor loaded should, preferably, be carried out using a drawbar load provided by a load car or any other similar device remotely positioned to avoid interference.

3.2 Location of the Microphone

3.2.1 The microphone shall be placed 200 ± 20 mm to the side of the centre line of the seat, the side being that giving the highest sound level as determined in a preliminary check made with the tractor operating in the gear giving the nearest forward speed to 7·5 km/h, with the maximum drawbar pull exerted, with a wheel slip of not more than 15 percent and with the engine speed not falling below the manufacturer's rated value.

3.2.2 The microphone diaphragm shall be facing forward and the centre of the microphone shall be 790 ± 50 mm above the seat reference point and 150 ± 20 mm forward of that point. Excessive vibration of the microphone must be avoided.

3.2.2.1 The seat reference point shall be determined in accordance with IS : 11806-1986* with the seat set at or as near as possible to the mid-point of its horizontal and vertical adjustment. Any suspension of the seat shall be depressed until the seat reaches the mid-point of its dynamic range.

NOTE — Attention is drawn to the possibility, particularly when a cab is fitted, of standing waves being present within 300 mm of the operator's ear position. Checks should be made by moving the microphone around in this area to delete such standing waves.

3.3 Measurement

3.3.1 A-weighted sound pressure level measurements shall be made in all field gears giving a rated speed from 4 km/h up to 17 km/h. These measurements shall be made in each gear with the governor control lever fully open, at the maximum drawbar pull attainable with wheel slip of not more than 15 percent or engine speed not falling below the manufacturer's rated value, and at 25 percent and 70 percent of this pull.

3.3.1.1 Do not make the tests in gears in which the forward speed exceeds the safety limits of the testing equipment.

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*Method for determination of seat reference point of agricultural tractors.

3.3.1.2 For infinitely variable transmissions, measurement shall be made at four transmission speeds equally distributed over the range of 4 to 17 km/h.

3.3.2 Each reading shall be taken over a 5 s period of stabilized running. The number of readings to be taken shall exceed the range, in decibels, of observed fluctuations.

3.3.3 For initial commercial tests, at least three measurements shall be made at each microphone position for each operating conditions. If the spread of results of sound pressure level obtained under any measuring condition exceeds 3 dB, further measurements shall be made until the readings of the three consecutive measurements fall within 3 dB. The arithmetic mean of all the measurements shall be calculated and reported together with the value at the load resulting in maximum noise in the gear giving speed nearest to 7·5 km/h, and any other gear for which the sound level is one dB or greater above the sound level obtained in the former gear.

3.3.3.1 When octave band sound pressure levels are measured, it is recommended that the machine be operated at the speed and under the load which give the highest sound level.

3.3.4 For batch testing purposes, it is sufficient to perform one measurement under each of the specified measuring conditions at selected microphone positions.

3.3.5 Any peak which is obviously out of character with the general sound pressure level being read shall be ignored.

3.3.6 The valves reported shall be rounded to the integral part of the mean of the readings for initial commercial tests, or of the reading for batch tests.

3.3.7 Optionally, at the manufacturer's request, octave band pressure levels over the centre frequency range 31·5 to 8 000 Hz may be reported in addition to A-weighted sound pressure level.

4. MEASUREMENTS AT BYSTANDER'S POSITION

4.1 Operational Conditions

4.1.1 The surface of an area of radius not less than 10 m about the centre of the site (the test area) shall consist of smooth concrete, or similar hard material, dry and free from acoustically absorptive materials such as, powdery snow, grass and ashes.

4.1.2 The surface of the track shall be dry and have a texture that does not cause excessive tyre noise.

4.2 Layout of Test Area — The centre line of the track (*CC*), a line (*PP'*) perpendicular to it and passing through the centre of the test area, and two lines (*AA'* and *BB'*) parallel to line *PP'* and 10 m from it shall be marked on the test track (*see Y* in Fig. 1).

4.3 Location of Microphones — A microphone each shall be located on line *PP'* on each side of the centre line and 7·5 m from it (*see X* in Fig. 1). The microphone shall be 1·2 m above ground level.

4.4 Measurements

4.4.1 Immediately before the test, the engine shall be brought to its normal operating temperature.

4.4.2 The tractor with its centre line over the centre line of the track, shall approach line *AA'* at a steady speed corresponding to the three-quarters of the maximum travel speed.

4.4.3 When the front of the tractor reaches line *AA'*, the throttle shall be fully opened as rapidly as practicable and held in that position until the rear of the tractor crosses line *BB'*.

4.4.4 The maximum sound pressure levels indicated during the passage of the tractor between the lines *AA'* and *BB'* shall be noted. If a sound peak obviously out of character with the general sound level is observed, the measurement shall be discarded.

4.4.5 The results shall be considered valid if the differences between two consecutive measurements made on the side of the tractor which gives the higher sound pressure level do not exceed 2 dB.

5. TEST REPORT

5.1 The test report shall be presented in the *proforma* given in Appendix A.

APPENDIX A

(*Clause* 5.1)

PROFORMA FOR NOISE MEASUREMENT TEST

1. General

a) *Tractor*

  i) Make
  ii) Model
  iii) Special feature (two wheel/four wheel drive)

b) *Cab* (if fitted)

  i) Make
  ii) Model
  iii) Description (cladding, etc)
  iv) Working condition (open/closed)

2. Noise at Operator's Position

a) Brief description of silencing system
b) Background noise level, dB (A)
c) Details of test site
d) Type of sound level meter
e) Type of octave filter and frequency analyser, if used
f) Date of test
g) Atmospheric conditions
  i) Temperature, °C
  ii) Pressure, kPa
  iii) Relative humidity, percent
h) Wind velocity, m/s
j) Test data

Sl No.	*Gear Used*	*Travelling Speed* km/h	*Sound Level* dB (A)	*Remarks*
(1)	(2)	(3)	(4)	(5)

k) One-octave band sound pressure levels, in decibels, for the following centre frequencies, in hertz (optional):

31·5	63	125	500	1 000	2 000	4 000	8 000

3. Noise At Bystander's Position

a) Brief description of silencing system
b) Background noise level, dB(A)
c) Details of test site
d) Type of sound level meter

e) Date of test

f) Atmospheric conditions

 i) Temperature, °C

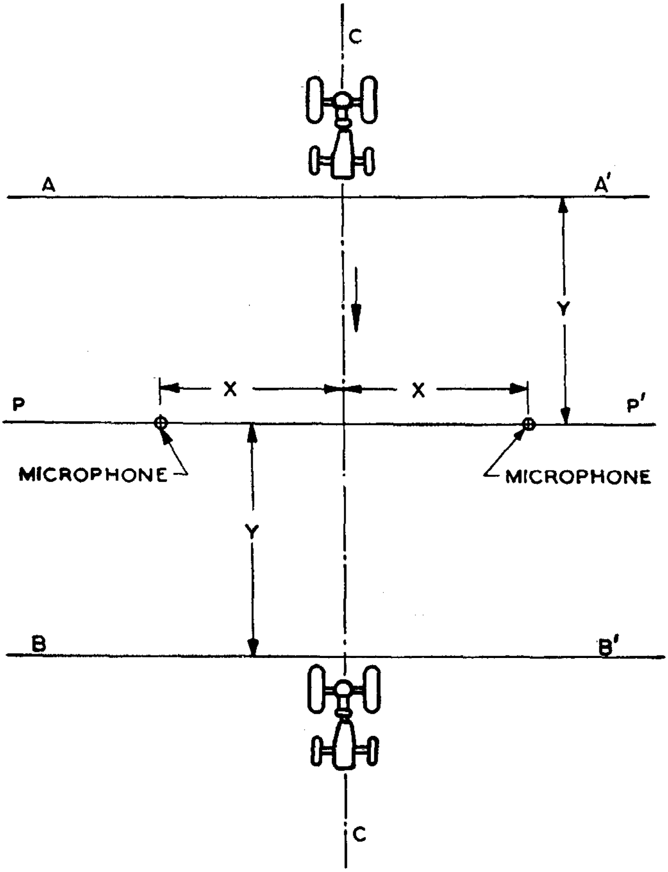
 ii) Pressure, kPa

 iii) Relative humidity, percent

g) Wind velocity, m/s

h) Test data

Sl No.	*Gear Used*	*Travelling Speed* km/h	*Sound Level* dB(A)	*Remarks*
(1)	(2)	(3)	(4)	(5)



All dimensions in millimetres.

FIG. 1 POSITIONS FOR MEASUREMENT OF AMBIENT NOISE EMITTED BY TRACTOR

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	$1\ \mathrm{N} = 1\ \mathrm{kg.m/s^2}$
Energy	joule	J	$1\ \mathrm{J} = 1\ \mathrm{N.m}$
Power	watt	W	$1\ \mathrm{W} = 1\ \mathrm{J/s}$
Flux	weber	Wb	$1\ \mathrm{Wb} = 1\ \mathrm{V.s}$
Flux density	tesla	T	$1\ \mathrm{T} = 1\ \mathrm{Wb/m^2}$
Frequency	hertz	Hz	$1\ \mathrm{Hz} = 1\ \mathrm{c/s}\ (\mathrm{s^{-1}})$
Electric conductance	siemens	S	$1\ \mathrm{S} = 1\ \mathrm{A/V}$
Electromotive force	volt	V	$1\ \mathrm{V} = 1\ \mathrm{W/A}$
Pressure, stress	pascal	Pa	$1\ \mathrm{Pa} = 1\ \mathrm{N/m^2}$

AMENDMENT NO. 1 JANUARY 1998
TO
IS 12180 : 1987 METHOD FOR NOISE MEASUREMENT OF AGRICULTURAL TRACTORS

(*Page* 6, *clause* 3.3.1, *line* 2) — Substitute '2 km/h to 17 km/h' *for* '4km/h up to 17 km/h'.

(*Page* 7, *clause* 3.3.1.2, *line* 3) — Substitute '2 km/h to 17 km/h' *for* '4 to 17 km/h'.

(*Page* 7, *clause* 3.3.6, *line* 1) — Substitute 'values' *for* 'valves'.

(FAD 32)

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